[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 33

[Docket No. XXXXX; Notice No. XX-XXX]

RIN 2120-XXXX

Airworthiness Standards; Aircraft Engine Standards for Engine Critical Parts

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed rulemaking (NPRM).

SUMMARY: The FAA proposes to amend the certification standards for original and amended type certificates for aircraft engines by modifying the standards for engine critical parts. The proposed rule would establish new and uniform standards for the design and tests of engine critical parts for aircraft engines certificated by the FAA and by the Joint Aviation Authorities (JAA).

DATE: Comments to be submitted on or before [insert date 90 days after the date of publication in the Federal Register].

ADDRESSES: Comments on this notice should be mailed, in triplicate to: Federal Aviation Administration, Office of the Chief Counsel, Attention: Rules Docket (AGC-200), Docket No. , Room 915G, 800 Independence Avenue, SW, Washington, DC 20591. Comments submitted must be marked: "Docket No. ." Comments may also be sent electronically to the following internet address: 9-NPRM-CMTS@faa.dot.gov. Comments may be examined in Room 915G on weekdays, except Federal holidays, between 8:30 a.m. and 5:00 p.m.

FOR FURTHER INFORMATION CONTACT: Tim Mouzakis, Engine and Propeller Standards Staff, ANE-110, Engine and Propeller Directorate, Aircraft Certification Service, FAA, New England Region, 12 New England Executive Park, Burlington, Massachusetts 01803-5299; telephone (781) 238-7114; fax (781) 238-7199.

SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to submit written data, views, or arguments on this proposed rule. Comments relating to the environmental, energy, federalism, or economic impact that might result from adopting the proposals in this notice are also invited. Substantive comments should be accompanied by cost estimates. Comments must identify the regulatory docket number and be submitted in triplicate to the Rules Docket address specified above.

The Administrator will consider all comments received on or before the closing date before taking action on this proposed rulemaking. The proposals contained in this notice may be changed in light of comments received.

All comments received, as well as a report summarizing each substantive public contact with FAA personnel on this proposed rulemaking, will be filed in the docket. The docket is available for public inspection before and after the comment closing date.

Commenters wishing the FAA to acknowledge receipt of their comments submitted in response to this notice must include a pre-addressed, stamped postcard on which the following statement is made: "Comments to Docket No. ." The postcard will be date-stamped and mailed to the commenter.

Availability of NPRMs

An electronic copy of this document may be downloaded using a modem and suitable communications software from the FAA regulations section of the Fedworld electronic bulletin board service (telephone: 703-321-3339), the Federal Register's electronic bulletin board service (telephone: 202-512-1661), or the FAA's Aviation Rulemaking Advisory Committee Bulletin Board service (telephone: 800-322-2722 or 202-267-5948).

Internet users may reach the FAA's webpage at http://www.faa.gov/avr/arm/nprm/nprm.htm or the Federal Register's webpage at http://www.access.gpo.gov/su_docs/aces/aces140.html for access to recently published rulemaking documents.

Any person may obtain a copy of this NPRM by submitting a request to the Federal Aviation Administration, Office of Rulemaking, ARM-1, 800 Independence Avenue, SW, Washington, DC 20591, or by calling (202) 267-9680. Communications must identify the docket number of this NPRM.

Persons interested in being placed on the mailing list for future NPRMs should request, from the above office, a copy of Advisory Circular No. 11-2A, Notice of Proposed Rulemaking Distribution System, which describes the application procedure.

Background

Part 33 of Title 14 of the Code of Federal Regulations, (14 CFR part 33) prescribes airworthiness standards for original and amended type certificates for aircraft engines. The Joint Aviation Requirements-Engines (JAR-E) prescribes corresponding airworthiness standards for the certification of aircraft engines by the Joint Aviation

Authorities (JAA). While part 33 and JAR-E are similar, they differ in several respects. For applicants seeking certification under both part 33 and JAR-E, these differences result in additional costs and delays in the time required for certification.

The FAA is committed to undertaking and supporting the harmonization of part 33 and the JAR-E requirements. In August 1989, the FAA Engine and Propeller Directorate participated in a meeting with the JAA, the Aerospace Industries Association (AIA), and the European Association of Aerospace Industries (AECMA). The purpose of the meeting was to establish a philosophy, guidelines, and a working relationship for the resolution of issues identified as needing to be harmonized, including the identification of the need for new standards. All parties agreed to work in a partnership to jointly address the harmonization effort task. This partnership was later expanded to include the airworthiness authority of Canada, Transport Canada.

This proposal has been selected as an Aviation Rulemaking Advisory Committee (ARAC) project. This task was assigned to the Engine Harmonization Working Group (EHWG) of the Transport Airplane and Engine Issues Group (TAEIG) and notice of the task was published in the Federal Register on XXXX (XX FR XXXX). On XXXX, the TAEIG recommended to the FAA that it proceed with the rulemaking.

Service experience with gas turbine engines has demonstrated that material, manufacturing and service induced anomalies do occur. These anomalies can potentially degrade the structural integrity of high-energy rotors. Conventional rotor life methodology ("safe-life" method) typically determines the approved life based on the minimum number of cycles required to initiate a crack approximately .030 inches in length. The "safe-life" technique is founded on the assumption that rotor components are

anomaly free (nominal condition). Consequently, the methodology does not explicitly address the occurrence of such anomalies, although some level of tolerance to anomalies is implicitly built-in using design margins, incorporating factory and field inspections, etc. Under nominal conditions, this safe-life methodology provides a structured process for the design and life management of high-energy rotors, which results in the assurance of structural integrity throughout the life of the rotor. Undetectable material processing, manufacturing and service-induced anomalies, therefore, represent a departure from the assumed nominal conditions.

In 1990, to quantify the extent of such occurrences the FAA requested that the Society of Automotive Engineers (SAE) reconvene the ad hoc committee on uncontained events. The statistics pertaining to uncontained rotor events are reported in the SAE committee report Nos. AIR 1537, AIR 4003, and SP-1270. While no adverse trends were identified, the committee expressed concern that the projected 5-percent increase in airline passenger traffic each year would lead to a noticeable increase in the number of aircraft accidents from uncontained rotor events which have the potential to cause catastrophic aircraft accidents. As a result of an accident in 1989, the root cause of which was traced back to a hard alpha anomaly in a titanium forging, the FAA requested the turbine engine manufacturers, through the Aerospace Industries Association (AIA), to review available techniques to determine if a damage tolerance approach could be introduced which, if appropriately implemented, could reduce the occurrence of uncontained rotor events. The industry-working group concluded that the technology was available to begin to implement enhancements to the conventional rotor life management process which would

explicitly address anomalous conditions, although additional development and research would be required.

In response to accidents and incidents due to manufacturing induced anomalies in high energy rotating components, for example a fan disk rupture in 1996 which was traced to a severely worked material surface layer in one tierod bolt hole introduced during the machining of the hole in the disk, a report was developed by a partnership of the Aerospace Industries Association (AIA) Rotor Manufacturing Project Team (RoMan) and the Federal Aviation Administration (FAA). Industry data shows that about 25% of recent rotor cracking/failure events have been caused by post-forging manufacturing induced anomalies. This reinforced the need to conduct damage tolerance assessments and the need to have strong links between the Engineering assumptions and the Manufacturing processes.

Discussion of the proposed rule

Rotor disk fracture continues to be the major contributor to propulsion risk. The current dominating causes for turbine engine rotor disk failures are material, manufacturing and operationally induced anomalies (for example, improper repair, fretting, corrosion, etc.). While compliance with the current requirements has resulted in significant improvements in rotor uncontained failure rates, incorporation of recently developed technologies and methodologies is expected to provide further improvement.

Experience with a number of different types of static parts has demonstrated that fatigue failures have the potential to result in hazardous effects. For example, some high-pressure casing fatigue failures have resulted in uncontained high-energy fragments and fire. In addition, the operating pressures of engines continue to rise thus increasing this potential. In some instances, the Engine Certification Office (ECO) has requested engine manufacturers to evaluate the fatigue capabilities of engine static structures with the use of an "issue paper" under section 33.19(a) that requires the engine be designed and constructed to minimize the development of an unsafe condition between overhaul periods. Even so, engine case ruptures continue to contribute to propulsion risk. Based on the CAAM (Continued Airworthiness Assessment Methodologies) data, case ruptures is the tenth leading cause that results in a significant (CAAM level 3 or 4) hazard to the aircraft for turbofan engines installed on part 25 airplanes.

The term "engine critical parts" is being introduced to cover all parts, rotating and static, which rely on meeting prescribed integrity requirements to avoid their primary failure, which is likely to result in an hazardous engine effect. The current rules for control of engine critical parts are deficient in a number of areas:

- FAR's do not contain a concise and coherent rule for the overall control of critical rotating parts in terms of design, manufacture and service/maintenance.
- FAR's do not contain fatigue life and integrity requirements for static parts that meet the definition of an engine critical part
- FAR/JAR-E do not contain requirements to account for the potential degrading effects of material, manufacturing or service induced anomalies.

Harmonization of JAR-E 515 with FAR 33.14 was initiated to eliminate significant differences that had been identified and to improve these requirements as necessary (for example the introduction of damage tolerance). While the current part 33 and JAR-E requirements for "engine critical parts" are similar they differ in several aspects:

- FAR part 33 does not require the engineering assumptions to be linked to the manufacturing processes used to produce the part.
- FAR part 33 does not require the engineering assumptions to be linked to the maintenance processes used in service.

The proposed rule establishes explicit structural integrity requirements for engine critical parts, adopting the general intent of current JAR-E 515 for both static and rotating engine critical parts, and it has been harmonized with the proposed revision of JAR-E 515.

Industry experience was utilized to identify those considerations that need to be addressed. The new harmonized rule defines engine critical parts as those parts that rely on meeting prescribed integrity requirements to avoid their primary failure, which is likely to result in a hazardous engine effect. In the context of this proposed rule, hazardous engine effects are the conditions listed in part 33.75. As noted above, current FAR's do not contain fatigue life and integrity requirements for engine static parts yet some of these parts meet the definition of an engine critical part. The new harmonized rule addresses all parts, rotating or static, which meet the definition of an engine critical part. The integrity of engine critical parts shall be established by linking of the Engineering, Manufacturing and Service Management Plans.

Current FAR requirements for rotors specifically address low-cycle fatigue, with

life limits (operating limitations) typically being based on crack initiation ("safe-life" method). The new harmonized rule, through the Engineering Plan, continues to address low cycle fatigue in the same manner as the existing rule, but also introduces requirements to conduct damage tolerance assessments to address the potential for failure from material, manufacturing and service-induced anomalies. The Engineering Plan is also required to address the continuing activities necessary to ensure that the approved life remains appropriate throughout the operational life of the engine. Engine critical parts are part of a complex system and other parts in the engine can influence the loads and environment to which they are subjected. Therefore, the Engineering Plan needs to consider these parts and changes to them. In addition, those attributes that are critical to the integrity of the part must be identified and controlled. In the context of this rule, attributes are inherent characteristics of the finished part that determine its capability.

The Manufacturing and Service Management Plans are developed to ensure that the attributes identified within the Engineering Plan are consistently manufactured and maintained throughout the lifetime of the part.

The general methods and approaches that are used to establish the approved lives for static engine critical parts are expected to be similar to those used for engine critical rotating parts. However, while life limits of engine critical rotating parts are typically based on the initiation of a crack ("safe-life"), experience with static parts has shown that the approved life for some of these components may use a portion of the crack growth life in addition to the crack initiation life.

The proposed harmonized FAR and JAR-E rules were developed by the EHWG and concurred with by the industry representatives who participated in the ARAC

discussions of this proposal. The proposal will be included in both part 33 and JAR-E in an effort to harmonize US regulations with existing and proposed requirements of the JAA.

Paperwork Reduction Act

The Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)) requires that the FAA consider the impact of paperwork and other information collection burdens imposed on the public. We have determined that there are no new information collection requirements associated with this proposed rule.

Regulatory Evaluation Summary

Proposed changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 directs that each Federal agency shall propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic impact of regulatory changes on small entities. TO BE COMPLETED…

Regulatory Flexibility Determination

The Regulatory Flexibility Act (RFA) of 1980, as amended, establishes as a principle of regulatory issuance that agencies shall endeavor, consistent with the objective of the rule and of applicable statutes, to fit regulatory and informational requirements to the sale of the business, organizations, and governmental jurisdictions

subject to regulation. To achieve that principle, the RFA requires agencies to solicit and consider flexible regulatory proposals and to explain the rationale for their actions.

TO BE COMPLETED…

International Trade Impact

The Trade Agreement Act of 1979…. TO BE COMPLETED

Unfunded Mandates Reform Act

Title II of the Unfunded Mandates Reform Act of 1995 (the Act), enacted as Pub. L. 104-4 on March 22, 1995, requires each Federal agency, to the extent permitted by law, to prepare a written assessment of the effects of any Federal mandate in a proposed or final agency rule that may result in the expenditure by State, local, and tribal governments, in the aggregate, or by the private sector, of $100 million or more (adjusted annually for inflation) in any one year.

This proposal does not contain a Federal intergovernmental or private sector mandate that exceeds $100 million in any year; therefore the requirements of the act do not apply.

Executive Order 13132, Federalism

The FAA has analyzed this proposed rule under the principles and criteria of Executive Order 13132, Federalism. We determined that this action would not have a substantial direct effect on the States, on the relationship between the national Government and the States, or on the distribution of power and responsibilities among

the various levels of government. Therefore, we determined that this notice of proposed rulemaking would not have federalism implications.

Environmental Assessment

FAA Order 1050.1D defines FAA actions that may be categorically excluded from preparation of a National Environmental Policy Act (NEPA) environmental impact statement. In accordance with FAA Order 1050.1D, appendix 4, paragraph 4(j), this proposed rulemaking action qualifies for a categorical exclusion.

List of Subjects in 14 CFR Part 33

Air transportation, Aircraft, Aviation safety, Safety.

The Proposed Amendment

In consideration of the foregoing, the Federal Aviation Administration proposes to amend part 33 of Title 14 Code of Federal Regulations (14 CFR part 33) as follows:

PART 33 - AIRWORTHINESS STANDARDS: AIRCRAFT ENGINES

1. The authority citation for part 33 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701-44702, 44704

2. Revise §33.14 to read as follows:

§33.14 Engine critical parts.

Engine critical parts are those parts that rely upon meeting prescribed integrity requirements to avoid their primary failure, which is likely to result in a hazardous engine effect. Typically engine critical parts may include discs, spacers, hubs, shafts, high-pressure casings, and non-redundant mount components. For the purposes of this section, a hazardous engine effect is any of the conditions listed in section 33.75. The applicant shall establish the integrity of each engine critical part by:

(1) An Engineering Plan, the execution of which establishes and maintains that the combinations of loads, material properties, environmental influences and operating conditions, including the effects of parts influencing these parameters, are sufficiently well known or predictable, by validated analysis, test or service experience, in order to establish an approved life for each engine critical part. Appropriate damage tolerance assessments must be performed to address the potential for failure from material, manufacturing and service-induced anomalies within the approved life of the part. The procedures by which the approved life is determined must be approved by the Administrator. The approved life must be published as required by section 33.4.

(2) A Manufacturing Plan which identifies the specific manufacturing constraints necessary to consistently produce engine critical parts with the attributes required by the Engineering Plan.

(3) A Service Management Plan which defines in-service processes for maintenance and repair of engine critical parts which will maintain attributes consistent with those

required by the Engineering Plan. These processes shall become part of the Instructions for Continued Airworthiness.

Issued in Washington, DC, on

[Name of Office Director]
Director, Aircraft Certification Service